Space Weather Technical Forecast

Issued on Friday, 23 June 2023 at 01:27 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: R1/R2 Radio Blackouts Likely throughout. Slight Chance of Minor Geomagnetic Storm days 1 and 2.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate in the last 24 hours, with GOES16 recording an impulsive M1.1 at 22/1121UTC and a M4.8 flare at 22/2344 UTC, both from AR3341. There are currently 16 regions on the visible disc, of which 10 are numbered. Out of these AR3341 has been the most active, but other regions have also produced C-class flares, mainly from AR3337 and AR3339. AR3337, AR3339, AR3340 and AR3341 have all been classified as beta-gamma. The remaining regions on the visible disc are magnetically simpler, but not all smaller in size, with AR3335 the largest on the disc. Most of the 16 regions on the disc have shown little or no change over the past 24 hours, apart for AR3337 which has rapidly increased in size and complexity, whilst AR3344 has rapidly declined.

Currently no new Earth directed Coronal Mass Ejections (CME's) are expected, despite a northwestern solar quadrant filament becoming mobile from 22/0300UTC, appearing to migrate westward by 0500UTC, with some minor dimming visible on AIA211. No associated CME has become apparent in available imagery.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR and ACE at L1, showed a declining weak connection to a negative polarity coronal hole high speed stream. The precise source is not certain, but is either the diffuse tail of CH15/-, or perhaps more likely the more pole-ward CH13/-. The phi angle was accordingly mainly negative (towards the Sun). Solar wind speeds started the period at slightly elevated levels around 475 km/s but then gradually decreased to end the day at background levels, around 380 km/s. The density was predominantly at average levels. The IMF was at weak levels throughout, peaking at 8 nT early in the day. The important north-south variation of the magnetic field was predominantly weakly south, reaching a maximum of -7nT early in the day. The net result of the above solar wind measures was for Quiet to Unsettled geomagnetic activity (Kp 1-3).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV), as observed by GOES16, was at Background levels.

High energy electron flux (greater than 2MeV), as observed by GOES16, started at Moderate levels and then increased to reach High levels (1000 pfu) 22/1320-1830 UTC. Thereafter the flux fell sharply, to background to moderate levels. The associated 24-hour fluence showed an increasing trend through the day, reaching 6.11e7 integrated pfu at 23/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is Likely to be Moderate, with isolated or occasional M-class flares and a Slight Chance of X-class flares.

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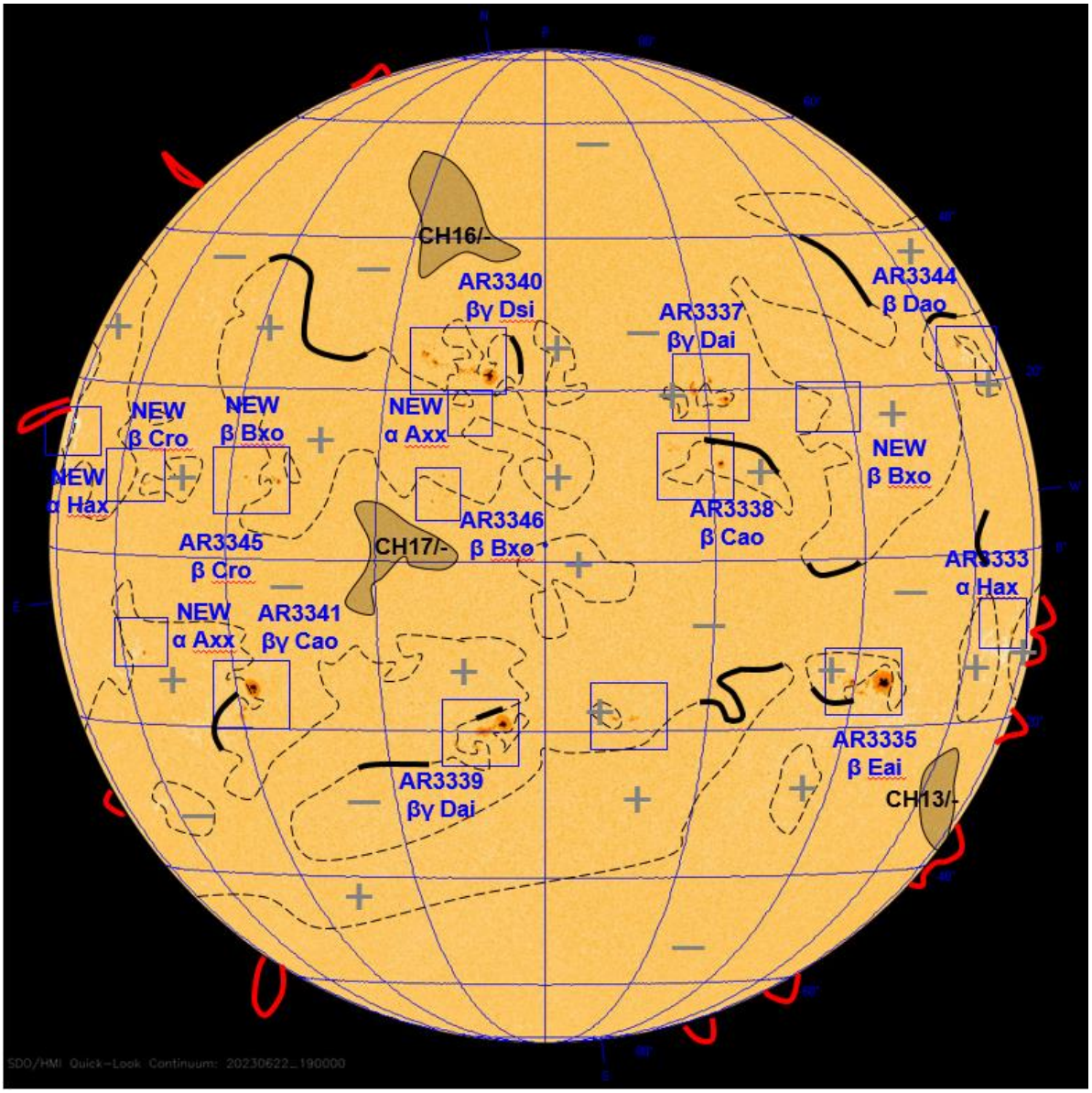
Solar Wind / Geomagnetic Activity: With no Earth directed CME's expected and only little or none coronal hole influence, no significant geomagnetic activity is expected. The solar wind is expected to remain at background to slightly elevated levels days 1 and 2 (23rd and 24th) under possible weak coronal hole influence from CH13. Geomagnetic activity is expected to be Quiet to Unsettled (Kp 1-3), with a slight chance of G1/Minor geomagnetic storms occurring today and early tomorrow. Thereafter background solar winds and Quiet (Kp 0-2) conditions are expected.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at Background levels, with a slowly increasing daily Slight Chance of S1. High energy electron flux (greater than 2MeV) is likely to be at background to moderate levels for most of the time, but with temporary peaks at High levels (1000 pfu) today and tomorrow. The corresponding 24-hour integrated fluence to most likely remain under the Active threshold.

Figure 1. Solar Analysis Valid 22/1900 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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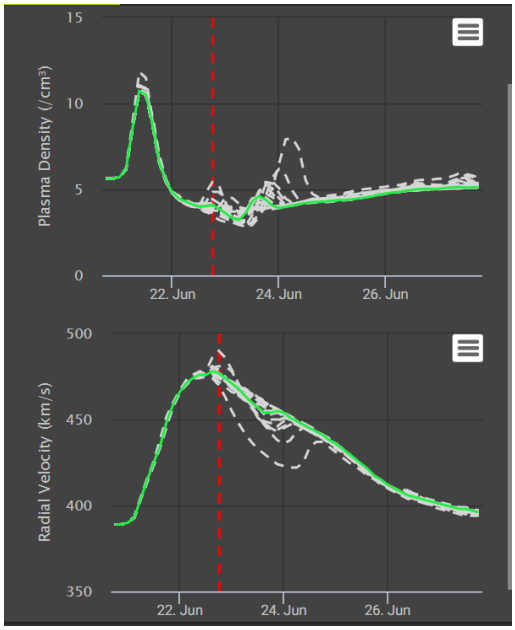
Geomagnetic Storms:

No definitively Earth-directed CMEs feature in this forecast, however it is possible that CMEs emitted east of the Sun-Earth line earlier this week may just bring a glancing blow either today or tomorrow - as shown by a minority of MOSWOC Enlil ensemble members. However, this not the favoured forecast, and the deterministic unperturbed run is preferred.

There is a chance of weak coronal hole influence at first, most likely from the now weak and faint CH13/- in the southern hemisphere. This combined with any glancing blow of a CME creates the slight chance of G1/Minor geomagnetic storms. Overall geomagnetic activity is expected to be Quiet to Unsettled (Kp 1-3), with a slight chance of G1/Minor geomagnetic storms occurring today and early tomorrow. Thereafter background solar winds and Quiet (Kp 0-2) geomagnetic conditions are expected.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	10	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: MOSWOC Enlil Ensemble



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Radio Blackouts - X-Ray Flares:

There is currently sixteen sunspot regions on the disc, of which 10 are numbered, with AR3342 now rotated onto the far side. AR3335 remains the largest region overall but is stable and magnetically simple. AR3337, AR3339, AR3340 and AR3341 are all smaller but moderately magnetically complex with beta-gamma configurations. AR3346 has shown the greatest change out of all the regions over recent hours, with a rapid decline to become Bxo/Beta. Slight growth occurred in some regions, including some of the still yet to be numbered regions, while many regions remained stable or showed weak decline.

Solar activity is expected to remain Moderate, with isolated M-class flares likely and a slight chance of X-class flares, these most likely from AR3341 but also from a new region that will emerge onto the eastern limb within the next 24 hours.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	60	60	60	60
Very Active	R3 to R5 X Class	No	10	10	10	10

Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux, as observed by GOES16, is at Background levels and expected to remain so throughout the period.
There remains a daily Slight Chance of reaching the S1/Minor Storm threshold given the sheer number of (bipolar) regions and complexity of the current front-side. On balance the risk is also felt to rise slightly, as fewer large sunspots are moving away from the western limb (on the far side) than are moving towards it (on the front side), leading to a gradual increase in risk, although it remains the case that no recent even very modest proton-generating events have been observed.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	10	10	15	15
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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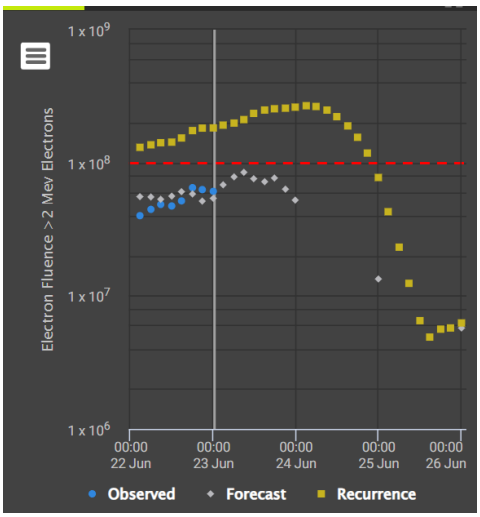
High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV) is likely to be at background to moderate levels for most of the time, but with temporary peaks at High levels (1000 pfu) today and tomorrow. The corresponding 24-hour integrated fluence to most likely remain under the Active threshold.

MOSWOC REFM is currently offering a forecast significantly below persistence levels, which is where the current observed values lie. Therefore, without any mechanism to significantly increase the high energy electron count, the REFM model is considered to be giving good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	20	20	10	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 3: MOSWOC REFM



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